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PORT STUDY NORCAL

SUMMARY PHASE I

prepared by FRANK C. BOERGER

PORT REQUIREMENTS
FOR THE
SAN FRANCISCO BAY AREA

PHASE I
SUMMARY REPORT

Prepared for

U. S. MARITIME ADMINISTRATION,
U. S. DEPARTMENT OF COMMERCE

and

THE NORTHERN CALIFORNIA PORTS AND
TERMINALS BUREAU, INC.

by

Frank C. Boerger

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INTRODUCTION

The Northern California Ports and Terminals Bureau, Inc. (NORCAL) has undertaken studies to investigate the long-term needs for facilities to accommodate international and domestic shipping in the San Francisco Bay Area. NORCAL was supported in this effort by the Western Region of the United States Maritime Administration (MARAD), U.S. Department of Commerce. Both NORCAL and MARAD recognized the need to establish a guide for future policy decisions on the development and use of facilities at Northern California ports. By initiating these studies, they can be assured that this cooperative planning is based on the industry's collective and expert analysis and support. In addition, these studies provide the basis for answering queries often raised by environmentalists concerning the need for port expansion and modernization projects. Finally, the ports will be able to demonstrate a definite relationship between growth in commerce and the required expansion of port capabilities.

By the participation of a majority of the San Francisco Bay Area ports, MARAD has been able to continue to pursue its objective of promoting cooperative port planning on a regional basis. Through these studies the synchronized development of U.S. ports, consistent with the growth of commerce and the development of advanced internationally competitive shipping systems, is envisioned.

The first phase studies reported herein were formulated to provide the bases for further development of plans for meeting the regional port needs as identified by the study. These NORCAL studies will provide the bases for development of a cooperative approach by interested entities in the Bay Area to the problem of maintaining and improving the Bay Area's role as a major shipping point for waterborne commerce by providing for efficient utilization of the natural and man-made facilities available in the area.

Initial studies were separated into two endeavors: The first, NORCAL-1, provided for estimates of the foreign and domestic waterborne cargo, excluding crude petroleum, that could be projected to pass through the Bay Area through the year 2020. The second, NORCAL-2, provided current port capacities for handling cargoes with emphasis on dry cargo facilities and excluding crude petroleum terminals. NORCAL-1 was conducted by Policy Planning Consultants of Palo Alto, California under contract to NORCAL. NORCAL-2 was accomplished by Manalytics, Inc. of San Francisco, California under contract to NORCAL. Responsibilities of both of these firms included developing a rational methodology that could be used not only in the specific estimates made for the Bay Area Ports included in NORCAL but also that could be used as a basis for making similar type estimates in other regions in the United States.

In particular, in NORCAL-2 a specific methodology has

been worked out and published separately so that the U.S. Maritime Administration can make it available as a planning tool to other port areas in estimating current marine terminal capacities. In addition, the methodology has been developed to provide a means for estimating the kinds of facilities and support equipment that would be required to handle a certain level of tonnage through a port terminal facility and for use in estimating the sizes of ports that will be required to meet future needs.

The purpose of this summary report is to provide a preliminary analysis of the short- and long-term future needs of the San Francisco Bay Area for port handling capacity based on the results of NORCAL-1 and NORCAL-2; that is, the future estimated needs for cargo transfer in Bay Area ports are measured against the current handling capacity of existing facilities in order to make estimates of the additional capacity that will be required in the future and the types of facilities that will be necessary to meet those requirements.

NORCAL is a nonprofit California corporation organized to provide for cooperation among the ports of Northern California in joint endeavors as determined by its Board of Directors. The NORCAL ports included in this study are

1. Encinal Terminals (Alameda)
2. Benicia Port Terminal Company
3. Port of Oakland

3. Port of Richmond

4. Port of San Francisco

Other members of NORCAL are the Ports of Sacramento and Stockton and the Solano County Development Agency and the Contra Costa County Development Association. The study ports are located in the San Francisco Bay Area of northern California as shown in Figure 1.

In this report the term "Northern California area" includes all of the region served through the Golden Gate; the cargo projections include tonnages expected at all facilities in the region not merely those utilizing the ports of NORCAL members. The "San Francisco Bay area" includes the port facilities in the Northern California region except the Ports of Sacramento and Stockton. The "NORCAL ports" include the five ports listed above, i.e., the privately-owned ports of Encinal Terminals and the Benicia Port Company and the publicly-owned ports of Oakland, Richmond, and San Francisco.

In addition to this Summary Phase I report, three other volumes contain the results of the studies:

NORCAL Port Study 1 - Cargo Projections

NORCAL Port Study 2 - Port Capacity Methodology

NORCAL Port Study 2 - Port Capacities

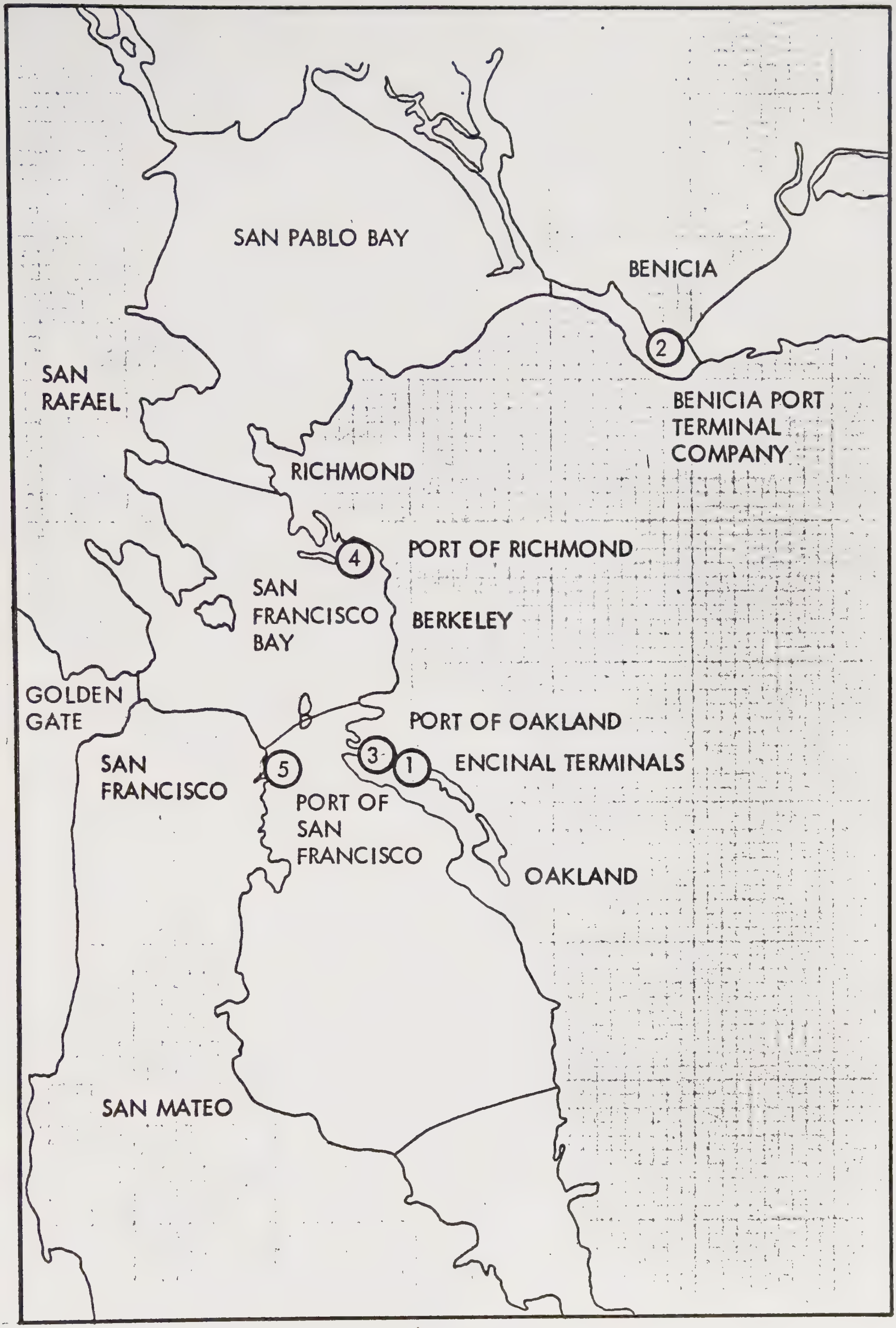

FIGURE 1
SAN FRANCISCO BAY AREA

CHAPTER I

CONCLUSIONS

The NORCAL studies conclude that there will be a need for increased port capacity to handle foreign and domestic dry cargo in the San Francisco Bay Area through the year 2020. The medium projection shows that, within 25 years by the year 2000, the NORCAL ports in the Bay Area will have to handle 1-1/2 times as much break-bulk cargo as in 1973; 2-1/2 times as much dry bulk cargo; and 9 times as much container/LASH/RORO cargo. Requirements by 2020 will approximately reach three times the above figures for 2000.

This medium projection is based on the following analyses:

1. World trade in dry cargo is projected to increase almost fivefold by the year 2000; that is from 1,190 million metric tons per year (1972) to 4,791 million metric tons per year. By 2020, it is expected to be over 12,000 million metric tons per year.

2. U.S. dry cargo foreign trade is expected to grow during the same period but at a lesser rate. From 352 million short tons per year (1972) increases to 1,156 million short tons per year by 2000 and to 2,468 short tons per year by 2020 are projected.

3. Dry cargo foreign trade through the ports of the Pacific Coast will increase from 62.3 million short tons per year (1973) to 365 million short tons per year in 2000 and 1,048 million short tons per year in 2020. This growth represents an increasing portion of U.S. trade; it is expected Pacific Coast trade will expand from 17 percent of U.S. trade in 1973 to 31.6 percent by 2000 and to 42.5 percent by 2020. Coastal, intercoastal, and domestic offshore trade will grow from 11.3 million short tons per year (1973) to

14 million short tons per year in 1980, 20.5 million in 1990, 27 million in 2000, and 45 million short tons per year in 2020.

4. The ports of Northern California dry cargo foreign and domestic trade will increase from 13.7 million short tons per year (1973) to 58 million short tons by 2000 and 164 million short tons by 2020. It is expected that Northern California ports will handle 10 to 20 percent of Pacific Coast trade.

5. Dry cargo foreign and domestic trade through the San Francisco Bay Ports will increase from 10.2 million short tons per year (1973) to 14 million in 1980, 27 million in 1990, 43 million in 2000, and 122 million short tons per year in 2020. The most significant growth will be in container/LASH/RORO cargoes, which will expand from 3.3 million short tons per year (1973) to 6 million in 1980, 17 million in 1990, 30 million in 2000, and 85 million short tons per year in 2020.

Facilities existing at present in the Bay Area to handle break-bulk and neo-bulk cargoes could accommodate the medium projection through 1990, although some conversion from break-bulk to neo-bulk facilities may be required. Present capacity will have to be doubled by 2005 to 2010 to meet the medium projection.

Dry bulk facilities at NORCAL ports handle only a portion of total movements of these commodities. Total needs for the Bay Area will be met by expansion of single-user terminals as well as in the publicly utilized ports.

Container/LASH/RORO requirements show a continuing dramatic increase; present capacity will have to be doubled in the 1980's to meet the most conservative projections.

Coordination of the port requirements with other demands for uses of the shoreline areas of the San Francisco Bay Area must be based on careful analyses of socio-economic, environmental, financial, and institutional factors. These requirements will have to be achieved in order to provide for the continuing viability of the Bay Area as a major shipping center.

CHAPTER II

CARGO PROJECTIONS

The cargo involved in world trade moves in ways to satisfy the needs of people. Developing nations have different needs than those that have already undergone the industrial revolution. Nations blessed with rich natural resources tend to be providers for other nations who have little. Industrial nations provide the output to meet needs of other nations and at the same time demand raw materials to provide a basis for manufacturing. The interrelationships between the producers and the consumers are complex and dynamic. Therefore quantities of materials expected to be moving in world trade have always proved to be difficult to predict. In addition to changing needs, changes in technology have provided dramatic shifts in emphasis in terms of materials moved and the methods for moving them.

In NORCAL-1, Policy Planning Consultants have demonstrated an approach to this problem that tends to smooth out the vagaries of annual changes by projecting on a longer term basis the upper and lower limits of growth in world trade that can be expected. The long-term projections tend to balance out specific events and annual variations due to severe climatic conditions, periodic and cyclic variations in the state of economic conditions in various nations of the world, and the perturbations caused by international tensions.

The analysis is based on a review of historical trends that link the patterns of world trade to the population and productivity of the nations of the world. The results show that the major portion (in monetary value) of world trade occurs between the advanced nations and consists of manufactured goods. On the other hand, the less developed countries' major volume (in monetary value) consists of primary commodities. Projections of these trends show that the advanced nations will continue to grow in per capita productivity at a faster rate than most of the less developed nations.

In order to quantify these broad perspectives, the total world dry cargo trade over the 20-year period, 1952 to 1972, was arrayed against the composite gross national products (GNP) of the U.S., Japan, and the European nations in the Organization for Economic Cooperation and Development (OECD). This historical information showed a high correlation between these two factors that was developed by trend analysis into an exponential function. This exponential trend was then used for projecting to 2020 the expected growth in GNP and world dry cargo projections. The medium projection of growth was based on a composite OECD growth rate of GNP of 4.6 percent with the high level of growth and the low level based on assumptions of GNP growth rates of 5.0 and 4.0 percent, respectively.

Figure 2 shows the envelope of projections that can be

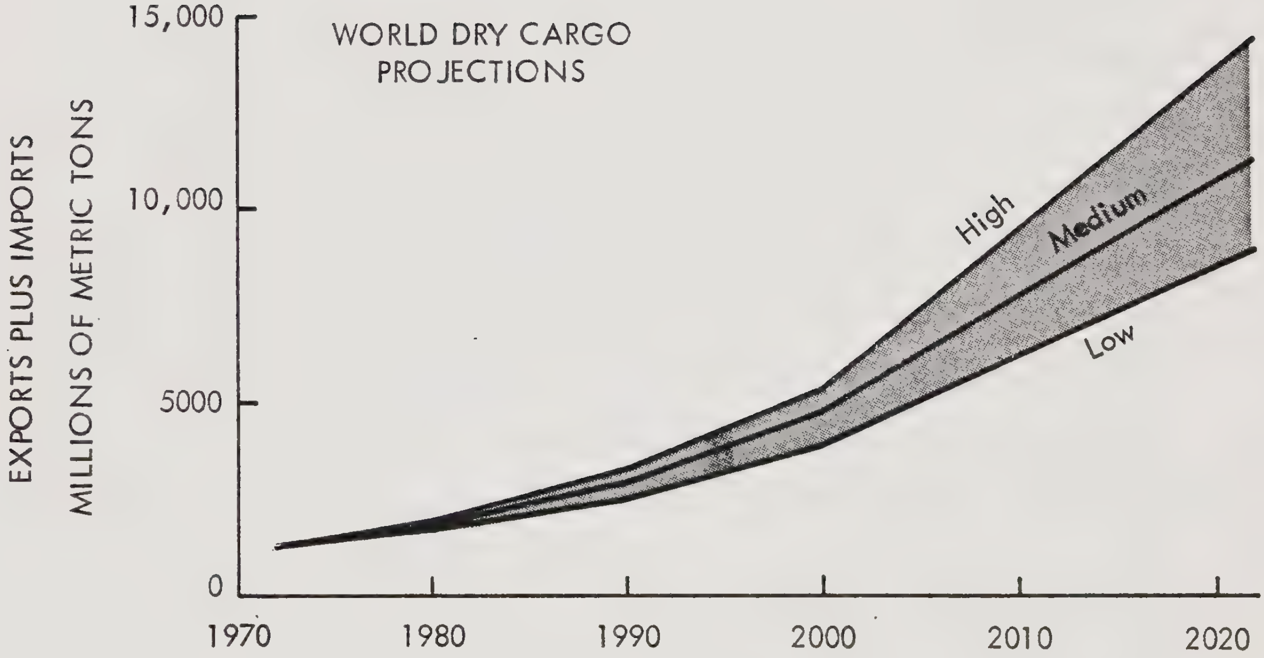
WORLD DRY CARGO PROJECTIONS
15,000
10,000
5000
0
EXPORTS PLUS IMPORTS
MILLIONS OF METRIC TONS
High
Medium
Low
1970
1980
1990
2000
2010
2020

FIGURE 2

expected in the world trade in dry cargo through the planning period. World trade in dry cargo is projected to increase almost fivefold by the year 2000; that is from 1,190 million metric tons per year (1972) to 4,791 million metric tons per year, based on a medium level of expansion. By 2020, it is expected to be over 12,000 million metric tons per year. A higher level of confidence in the accuracy of the projections is expected, of course, for the nearer term with less confidence in the long term. Comparisons with historical trends show that a high degree of confidence can be expected in the estimates for the end of the 20th century.

Further analyses of this dry cargo trade to estimate the nature of the movements for planning purposes indicate the proportions of bulk cargo and general cargo that can be forecast. In addition to the major commodities, iron ore, coal, grain, bauxite, and phosphates, there is a wide variety of other materials that can be categorized as "bulkable." Based on the medium projections of world dry cargo trade, bulk cargo movements will constitute 66 percent of the volume in 1980, 71 percent in 1990, and 77 percent in 2000. Therefore, general cargo will drop from 40 percent in 1972 to 23 percent in 2000.

U.S. Foreign Trade

As a continuation of the methodology used in forecasting world trade, U.S. foreign trade for the planning period was estimated. Significant factors affecting U.S. trade that

can be applied directly include: (a) the ratio of U.S. foreign trade to national income has been declining regularly from 1800 to the present time as the nation became more industrialized; (b) trade with Japan has grown at a much greater rate in the last 15 years than trade with European nations or the rest of the world; (c) trade with the Communist states, particularly with the USSR and China, has contributed a very small portion of total U.S. dry cargo trade.

These factors are discussed in greater detail below and more fully in NORCAL-1.

In the past 75 years the nature of trade of the U.S. has changed. At the beginning of the century unprocessed crude materials and foodstuffs constituted about 45 percent of the total value of both exports and imports. By 1940, 9 percent of the value of exports and 54 percent of the value of imports were these crude materials. By 1971, 15 percent of the value of both imports and exports were crude materials. The remaining percentages consisted of finished and semifinished manufacturers and foodstuffs.

These trends affect the nature of U.S. dry cargo trade; the prediction of the magnitude is again linked to the growth of the GNP. Analysis of the historical relationship provides a very high correlation so that a composite function has been derived for use in making projections for the planning period.

U.S. dry cargo projections were made for the planning period based on the correlation with the growth of the GNP and

are shown in Figure 3. The medium projection for this growth is based on a GNP growth rate of 3.6 percent with a high projection based on 4.1 percent and the low projection based on 3.0 percent. The higher and lower limits are based on population projections for the United States in which the higher population is essentially a continuation of the traditional three children per family norm while the lower rate is based on a more recent trend of two children per family.

A comparison of the world trade dry cargo growth projections and those of the United States show that the United States will have a decreasing portion of the world trade. From 1952 to 1972 the ratio of U.S. trade to world trade decreased from 17.9 to 13.4 percent. The best estimate based on these analyses shows that it will continue to decrease in the future so that in 1980 U.S. trade will be approximately 13.2 percent of world trade, in 1990 approximately 12 percent, in the year 2000 approximately 10.9 percent, and in the year 2020, 9.1 percent of the world trade.

The changing pattern of U.S. trade has also reflected changes in distribution to various trading partners over recent years. During the years 1968 to 1974, trade with Japan increased, with OECD Europe decreased, and with the rest of the world it increased in percentages based on value. In particular, in the past 15 years the ratio of U.S. trade with Japan to total U.S. trade has doubled. Growth in this trade can be expected to continue as total Japanese trade grows to equal and eventually exceed the value of U.S. trade.

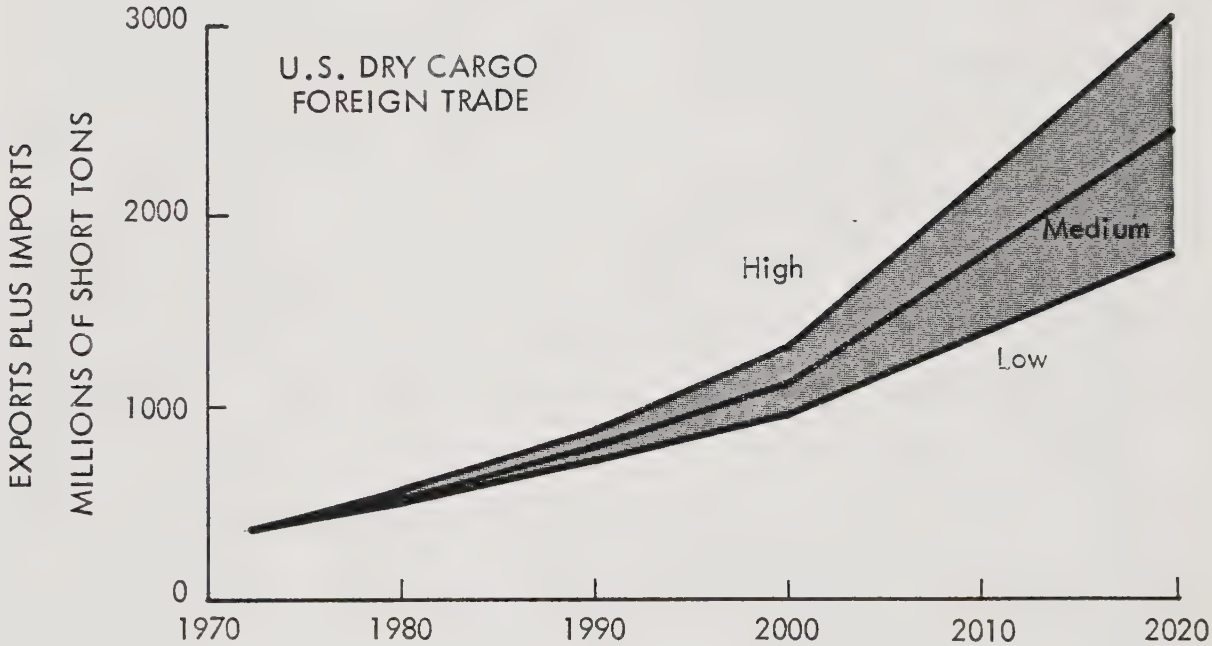
U.S. DRY CARGO FOREIGN TRADE
EXPORTS PLUS IMPORTS
MILLIONS OF SHORT TONS
3000
2000
1000
0
High
Medium
Low
1970
1980
1990
2000
2010
2020

FIGURE 3

Trade with the Communist States, since it is based on a controlled system for economic development, is not subject to the same types of trend analysis as described for other parts of the world. Trade with the USSR and with the Peoples Republic of China has not constituted a significant portion of U.S. trade in recent years nor is it expected to grow significantly in the near future. Possibilities for imports of bulk commodities (petroleum and LNG) exist in the long term.

Exports of cotton and wheat to these countries will continue on a sporadic basis depending on their annual harvests and concomitant needs. Changes in trading policies of either of these two Communist nations to promote foreign trade would push the U.S. projections to the higher values shown in Figure 3.

As shown in Table I, based on the medium projections of U.S. dry cargo trade, bulk cargo will constitute a decreasing portion of total trade: 66 percent of the volume by 1980, 56 percent by 2000 and 42 percent by 2020. Special cargo and neo-bulk shipments will increase twentyfold by 2020.

Table I

U.S. DRY CARGO FOREIGN TRADE PROJECTIONS
MEDIUM RANGE
MILLIONS OF SHORT TONS

	1972	1980	1990	2000	2020
Total dry cargo	352	516	780	1156	2468
Major bulk cargo	257	339	500	642	1047
Other and neo-bulk	45	98	172	332	927
General cargo (liner)	50	79	108	182	494

Pacific Coast Trade

Trade through the Pacific Coast ports has been increasing as a percentage of total U.S. trade in the past two decades. During the period 1959 to 1973 the Pacific Coast dry cargo foreign trade increased from 9.2 to 17 percent of the total waterborne dry cargo imports and exports of the United States. Three major influences shaped this development. They include

1. Economic growth of the Pacific Coast States relative to the rest of the United States;

2. The economic growth of other Pacific basin countries, including Japan, Korea, Taiwan and Australia;

3. The growing practice of shippers in the U.S. and the Pacific basin of handling trade through west coast ports regardless of origin or destination in the United States.

The first of these influences has been gradual in this decade with the Pacific States generating an incrementally larger portion of the GNP.

On the other hand the economic growth rates of the major trading partners have been large in recent years, with Japan, Taiwan and Korea each expanding at about 10 percent per year. This growth has contributed to an increase in trade with Japan at an average of 18 percent per year between 1968 and 1973, while South Korea trade increased 24 percent per year and Taiwan trade increased 28 percent per year.

The third influence is based on the developing procedures for overland common point (OCP) shipping and for

mini-bridge shipping. These practices provide for intermodal transportation between the Pacific Basin ports, through West Coast ports, and distant inland points outside of the traditional hinterland of the port complexes on the west coast, many of them east of the Rocky Mountains. OCP movements include through service between the ports and inland points. Mini-bridge provides service between Gulf and East Coast ports and West Coast ports via rail rather than all water routes.

These practices have not been widely applied to dry bulk cargoes, but have found application to dry cargoes susceptible to intermodal handling operations, particularly container traffic. In 1974, Seattle handled 51 percent of OCP cargoes; at the same time, 85 percent of the mini-bridge cargo passed through California ports. Faster transit time is a major factor in utilizing these types of services, although cost savings are important in OCP procedures. Lower transit time provides the ability to reduce inventories in distribution systems, thereby providing additional savings.

The land bridge concept of transshipping across the United States by rail for reshipment from East Coast ports to destinations in Europe will also have a growing influence on the amount of dry cargo that is handled by the West Coast ports. The limitations of the Panama Canal, in terms of accomodation of sizes of ships and the potential uncertainty of its availability on the long-term basis, can also cause increases in the utilization of land bridge and mini-bridge techniques

for shipments from the Pacific to U.S. and European destinations.

Based on an analysis of the factors outlined above, plus the influence of the nature of the commodities which are being traded in the Pacific Basin, it is possible to forecast that the ratio of Pacific Coast foreign trade tonnage to U.S. tonnage will grow in the planning period. Whereas Pacific Coast trade was 17.0 percent of the U.S. tonnage in 1973, it is projected to be 20.8 percent by 1980, 26.2 percent by 1990, 31.6 percent by the year 2000 and 42.5 percent by the year 2020. Development of this trade as measured against the total U.S. foreign dry cargo trade is shown in Figure 4.

The medium projection for dry cargo foreign trade through the ports of the Pacific Coast will increase from 62.3 million short tons per year (1973) to 365 million short tons per year in 2000 and 1,048 million short tons per year in 2020. These projections for foreign dry cargo trade through the planning period are shown in Figure 5.

In addition to foreign trade, projections of coastal, intercoastal and domestic offshore trade must be considered. For this trade the rate of growth is not as spectacular as the rate of growth in foreign trade. However, it is still expected to grow from 11.3 million short tons per year in 1973 to 14 million in 1980, 20.5 million in 1990, 27 million in the year 2000 and 45 million in the year 2020. This then

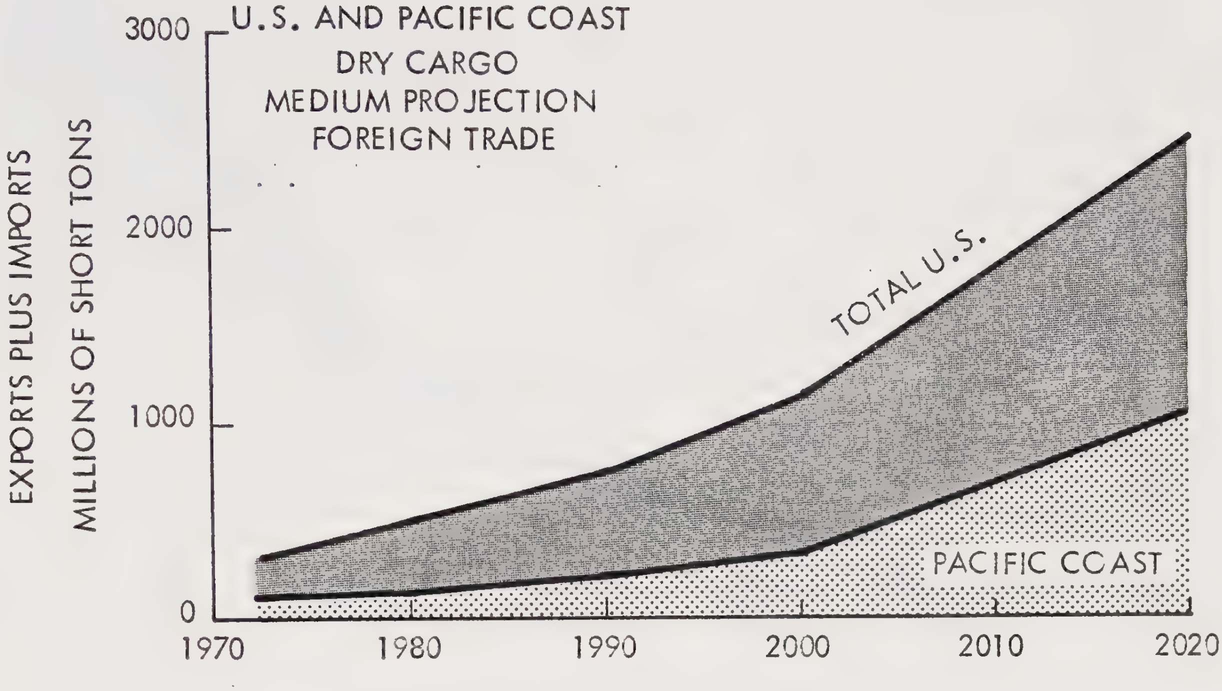
U.S. AND PACIFIC COAST
DRY CARGO
MEDIUM PROJECTION
FOREIGN TRADE
EXPORTS PLUS IMPORTS
MILLIONS OF SHORT TONS
3000
2000
1000
0
TOTAL U.S.
PACIFIC COAST
1970
1980
1990
2000
2010
2020

FIGURE 4

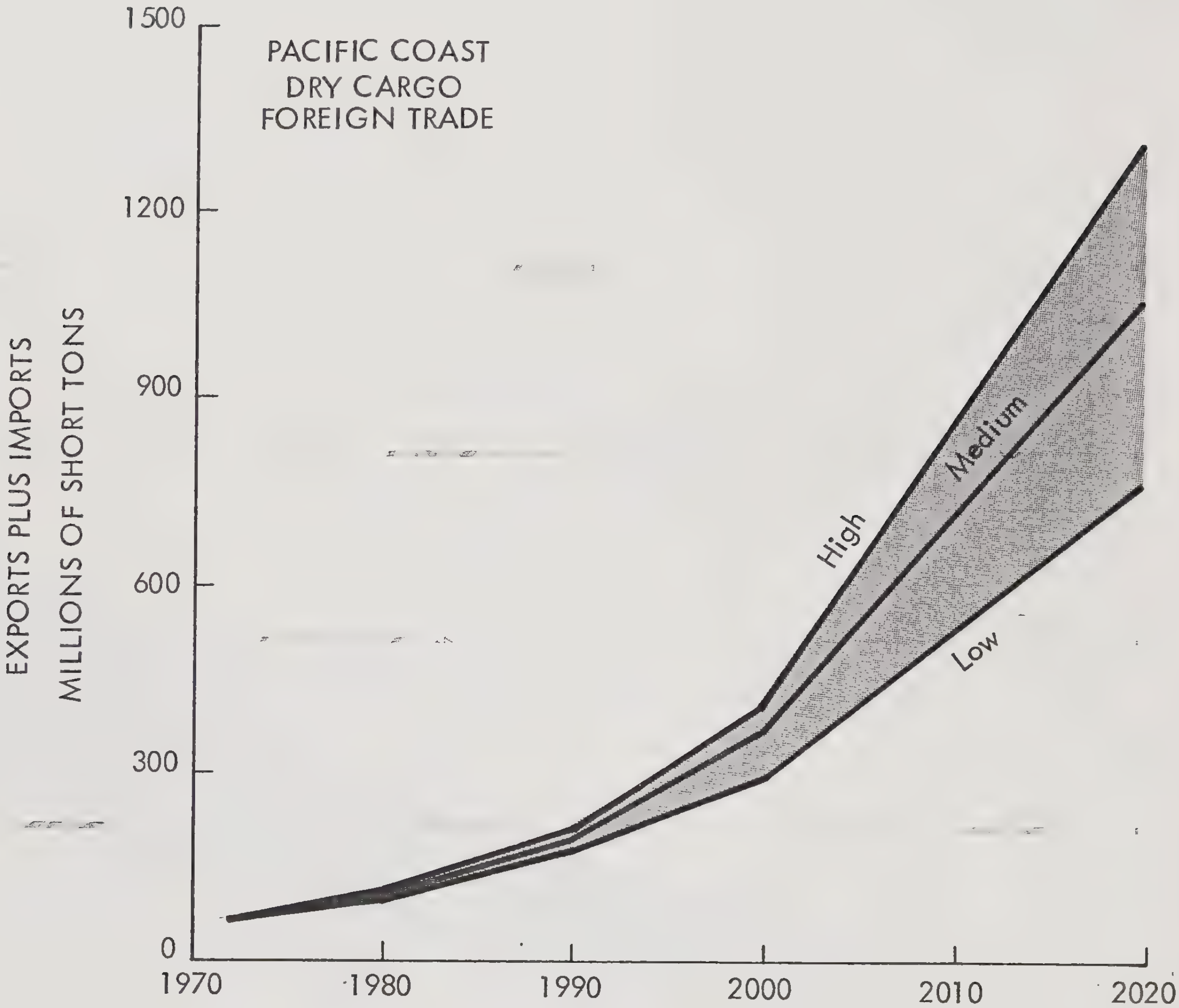
PACIFIC COAST
DRY CARGO
FOREIGN TRADE
EXPORTS PLUS IMPORTS
MILLIONS OF SHORT TONS
1500
1200
900
600
300
0
1970
1980
1990
2000
2010
2020
High
Medium
Low

FIGURE 5

points to the fact that Pacific Coast foreign and domestic trade tonnage will amount approximately to a low projection of 325 to a high projection of 445 million tons per year by the end of the century.

Northern California - San Francisco Bay Area Trade

Northern California dry cargo trade has been evaluated in respect to developments of the other major complexes along the Pacific Coast, namely the Los Angeles area and the Pacific Northwest. Many factors can affect the development of trade in the Northern California area in the planning period. Some of these factors will be based on local decisions such as additional facilities constructed, modernization of existing facilities, depth of channels and localized intermodal transportation facilities available. Other considerations include the utilization of the railroad network to the interior of the country and the method of operation of the shipping companies.

In 1974, the ports of Northern California handled 14 percent of the dry cargo tonnage on the Pacific Coast. They handled 20.2 percent of the general cargo, but only 11.2 percent of the dry bulk cargoes. Analysis of recent trends in the Northern California ports show that break-bulk cargo tonnages have remained at the same annual level in the 1970's, whereas containerized cargo has increased at a rate of 19.2 percent per year. Dry bulk cargoes have increased at a rate

of 6.7 percent annually during the same period.

Since it has been estimated that 75 to 80 percent of general dry cargo is "containerizable," future trends indicate continued growth in that mode of cargo handling. The variety of goods being placed in containers has been growing rapidly with more commodity types accommodated in the 1970's.

In addition, the growth of the OCP and mini-bridge shipments has contributed to increased containerized traffic. This growth has been reflected in the NORCAL ports during the 1970's in the following way: while the proportional share of OCP and mini-bridge imports has diminished, the proportion of OCP and mini-bridge exports has however increased at a higher rate.

A combination of factors explain these trends; they include the facilities available at each port area, the rail service connections to the central and eastern United States, and the choices of the steamship lines in organizing their routes and ports of call.

Development of port facilities is dictated by physical, environmental, socio-economic, and political constraints. The NORCAL ports face strong competition with the Southern California and Pacific Northwest areas in providing for modern facilities to meet the needs of shippers.

Direct rail connections by some major trunk lines have influenced the choice of overland routes by shippers for OCP cargoes. The ability to rehandle containers at inland points

by the various railroad companies will affect the choice of rail lines used.

The steamship lines themselves base their choices of routes on (1) volumes of cargo to be moved to various destinations, (2) time required on the sea lanes, (3) time in port for handling cargoes, and (4) relative costs involved in all of these matters.

The results of these interrelated factors have developed certain trends in recent years. There is some preference for the Pacific Northwest as a first port of call for traffic from Asian ports in the Northern Hemisphere due to geography, and some preference for Southern California as a first port of call due to large volumes of import cargo. At the same time the NORCAL ports are generally the second port of call (or last port of call) and export more OCP cargo than the other two areas combined; that is, 315,505 revenue tons for NORCAL versus 130,167 revenue tons for Southern California and 41,833 revenue tons for the Pacific Northwest in 1974.

Based on the analyses of these factors, it is expected that Northern California ports will maintain approximately the same percentage of overall trade that passes through Pacific ports as they do at the present time. Thus, the projections for dry cargo trade in Northern California were based on, for the medium projection, 15 percent of the Pacific Coast trade with the higher limit being 20 percent of the higher limit of West Coast trade and the lower projection being 10 percent of

the lower projected Pacific Coast trade.

The ports of Northern California dry cargo foreign and domestic trade will increase from 13.7 million short tons per year (1973) to 58 million short tons by 2000 and 164 million short tons by 2020.

Further refinement of these figures is necessary in order to determine what cargo will pass through the ports in the San Francisco Bay Area proper as opposed to those other Northern California ports located in the Delta Region, the Ports of Stockton and Sacramento.

Overall trends provide a basis for estimating that general cargo will account for about 65 percent of Northern California dry cargo trade by the year 2000 and that container ships and Lighter Aboard Ship (LASH) will account for 85 percent of that general cargo trade.

In addition it is projected that the increases in general cargo handling will be larger in the San Francisco Bay Area ports than those in the Delta, whereas the Delta ports will have the greater growth in handling dry bulk cargoes.

Based on these projections and the general ratio of bulk to containerized shipment, projections of foreign and domestic trade for the San Francisco Bay Area were made. These projections show that dry cargo foreign and domestic movements through the San Francisco Bay Ports, based on the medium projection, will increase from 10.2 million short tons per year (1973) to 14 million in 1980, 27 million in 1990, 43 million

in 2000, and 122 million short tons per year in 2020. These projections are shown in Figure 6. Figure 7 shows the portion of the Pacific Coast trade that is expected to move through the Bay Area. Based on the breakdown of dry cargo into types as described above, Figure 8 shows the medium level growth of the projections for container, break-bulk, and dry bulk cargoes that are estimated for the San Francisco Bay Area ports through the planning period. The most significant growth will be in container/LASH/RORO cargoes, which will expand from 3.3 million short tons per year (1973) to 6 million in 1980, 17 million in 1990, 30 million in 2000, and 85 million short tons per year in 2020.

These figures demonstrate that there will need to be, within 25 years by the year 2000, a capacity to handle 1-1/2 times as much break-bulk traffic as is being handled at the present time, 2-1/2 times as much dry bulk traffic, and 9 times as much container traffic. The figures further show that by the end of the planning period (2020), facilities in the Bay Area will need to handle 4 times as much break-bulk traffic, 7 times as much dry bulk and 25 times as much container traffic than as at the present time. These estimates are based on using the medium projection for dry cargo and, as has been demonstrated, could vary appreciably if the course of events were to cause the trend to go toward the higher or lower projection levels.

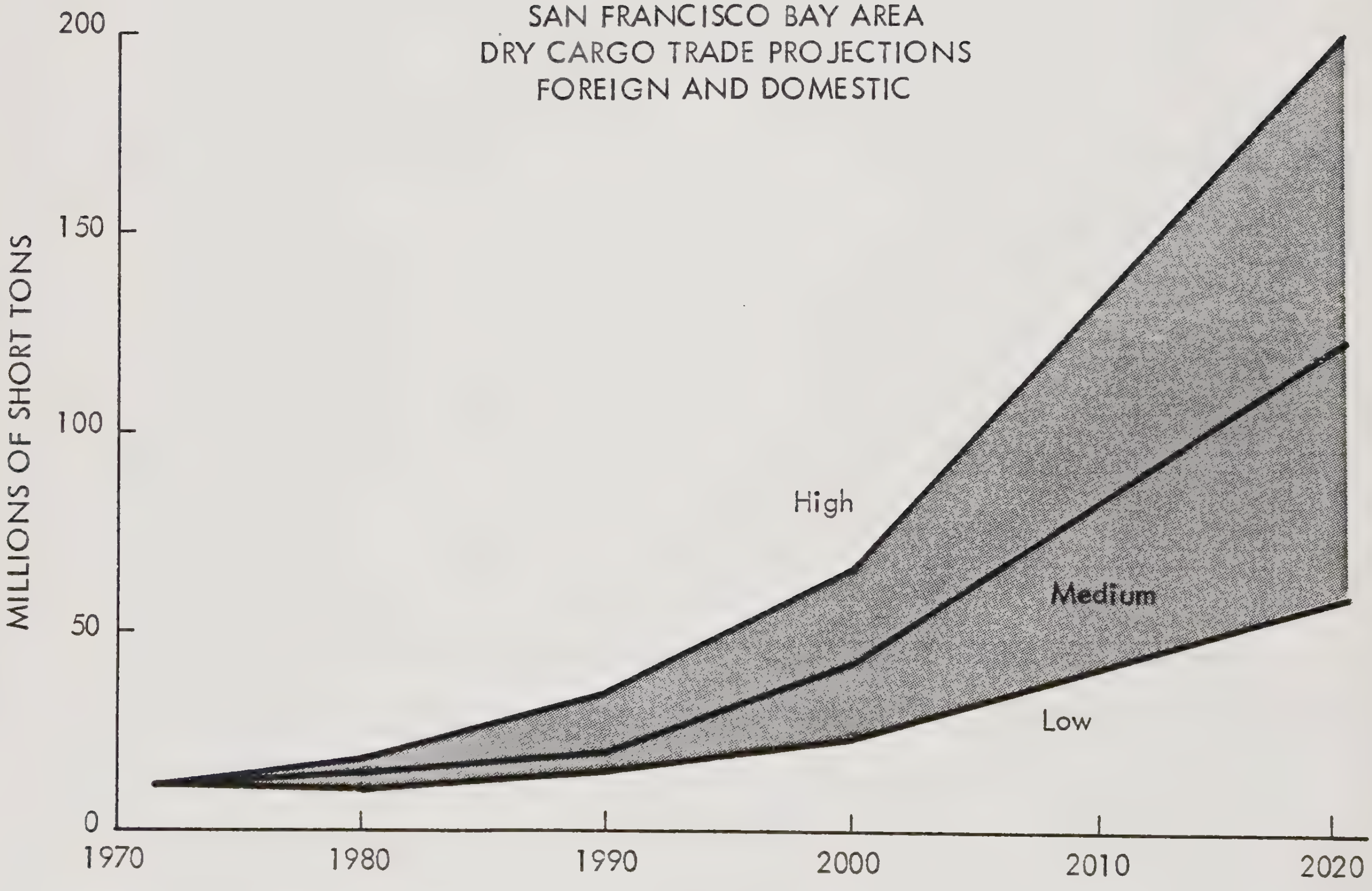
SAN FRANCISCO BAY AREA
DRY CARGO TRADE PROJECTIONS
FOREIGN AND DOMESTIC
MILLIONS OF SHORT TONS
200
150
100
50
0
1970
1980
1990
2000
2010
2020
High
Medium
Low

FIGURE 6

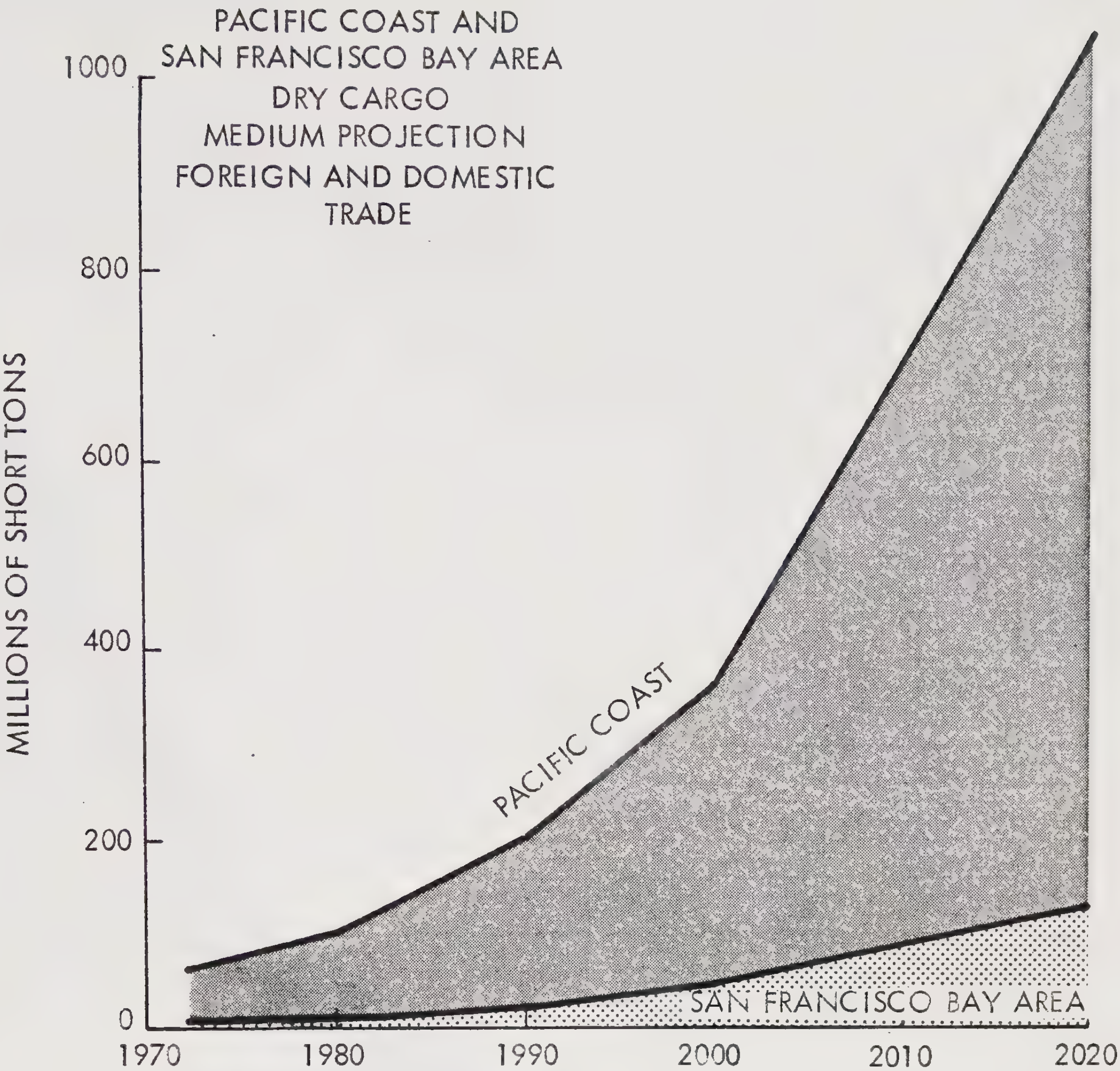
PACIFIC COAST AND
SAN FRANCISCO BAY AREA
DRY CARGO
MEDIUM PROJECTION
FOREIGN AND DOMESTIC
TRADE
MILLIONS OF SHORT TONS
1000
800
600
400
200
0
PACIFIC COAST
SAN FRANCISCO BAY AREA
1970
1980
1990
2000
2010
2020

FIGURE 7

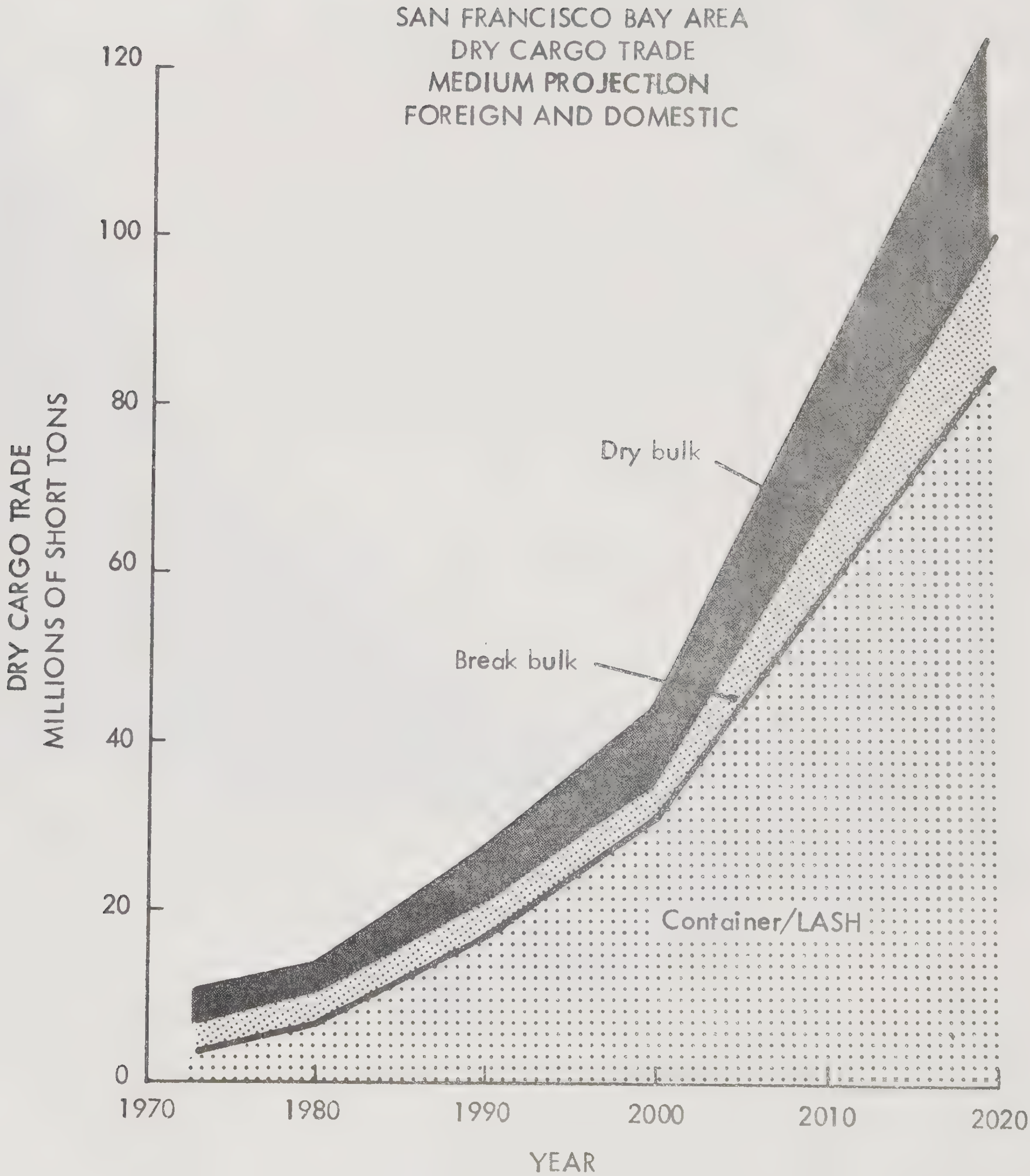
SAN FRANCISCO BAY AREA
DRY CARGO TRADE
MEDIUM PROJECTION
FOREIGN AND DOMESTIC
DRY CARGO TRADE
MILLIONS OF SHORT TONS
120
100
80
60
40
20
0
Dry bulk
Break bulk
Container/LASH
1970
1980
1990
2000
2010
2020
YEAR

FIGURE 8

Liquid Bulk Cargoes

An initial attempt was made to analyze the problem of liquid bulk receipts and shipments for the San Francisco Bay Area excluding crude petroleum. The transportation of these products was so fully dependent on the movement of crude petroleum that an independent analysis could not be made. Studies of the overall energy situation and the potentials for further development along the Pacific Coast of additional refineries or additional capacity for existing refineries has been reflected in a Corps of Engineers' study: West Coast Deep Water Port Facilities Study, dated June, 1973. Determination of reactions to this study has not yet been made at the national or state level. Major policies involving transportation of oil from Alaska and importation from foreign nations are still developing. Because of these uncertainties, the refineries of the San Francisco Bay Area have not been able to develop, with certainty, plans for receipt of the crude petroleum nor, therefore, the programs for refining and transshipping the products.

As stated in the introduction to these present studies, both public and privately owned general cargo ports were included in the analysis of the capacity for port facilities that exist in the Bay Area at the present. The capacities of the privately owned facilities used primarily for transshipment of specific bulk commodities, particularly liquid bulk commodities, have not been considered. The major conclusion here is that those privately owned facilities which will be

capable of receiving the increased amounts of crude oil that are required to produce energy in this area will also be able to handle the increased outshipment of the products by water transportation. Currently other modes of transportation handle large amounts of these products including rail, truck and pipeline transportation.

Another aspect of development for energy sources provides for the possibility that a single liquified natural gas (LNG) facility may be necessary in the Bay Area during the planning period. This speculation is again based on policies that have not yet been determined for transportation of natural gas from sources in Alaska as well as the possibility for developing foreign sources for this energy.

CHAPTER III

PRESENT PORT CAPACITIES

Ports provide the terminal facilities to transfer materials from waterborne vessels to the shore or from shore onto the vessels. The means for accomplishing this intermodal movement varies in the ports of the world from manhandling cargo aboard sampan lighters to semi-automated loading and unloading facilities. In the NORCAL-2 study an analysis of a variety of types of terminals, as used in the United States, was made by Manalytics, Inc. The methodology provides the basis for estimating port capacity in terms of the throughput tonnages that can be handled. The methodology suggested then was used to estimate the capacities of the NORCAL ports in the San Francisco Bay Area.

The basic elements that must be considered in determining terminal throughput capacities are (1) the nature of the trade, (2) the resources available, (3) the method of operation, and (4) the administrative and institutional practices at the terminal. Since each one of them represents a variable, the combinations of these variables will vary from terminal to terminal. Each terminal can be characterized as a unique grouping of some subtle shadings of these four factors.

The nature of the trade depends on the terminal's customers. The customers include the ship operators, the shippers and consignees, the transportation companies plus their agents and representatives.

They impose constraints on the terminal based on the operations and types of ships used, including times of arrival, turnaround and departure. On-board equipment, methods of stowing and amounts of cargo determine the response required from the terminal operator.

Customers can apply constraints based on landside factors such as method and times of delivery and pickup, waiting times that can be tolerated, and services required.

Certain commodities require special handling or special equipment that can constitute an additional constraint.

The resources available at a terminal include the cargo handling equipment, the storage facilities and the labor force. Some of these resources can be managed to meet peaks in demand; others tend to act as constraints, such as major pieces of equipment or special types of facilities.

The methods of operation provide both opportunities and constraints. The direct operating system is designed to optimize the utilization of the resources and is changed as needed to meet new demands. Work practices are dictated by labor contracts, which are the basis for economic decisions on when and how long to work.

The fourth basic element that determines throughput capacity depends on the administrative and institutional arrangements at the terminal. Affecting throughput are the characteristics classified as the indirect operating system. This system includes consideration of the communications and control within the terminal and of the organization of information

to permit speedy data retrieval. Management policies play a significant role in the utilization of the terminal to meet the needs of specific ship operators.

The methodology developed for estimating capacity attempts to quantify the throughput capacity based on experience in the San Francisco Bay Area, particularly, and in the United Stated generally. The approach used establishes an <u>intrinsic capacity</u> of each type of terminal and then applies modifiers based on resource time, cycle time, and storage capacity to the specific types of facilities and equipment that are available at the terminal to evaluate an <u>effective capacity</u>.

The intrinsic capacity is an unreachable goal. To cite a parallel example, a person who owns an automobile could drive it 8,760 hours per year. If he travelled in the cities with a speed limit of 25 miles an hour, he could travel 219,000 miles a year. If he travelled on the highways at 55 miles per hour, he could travel 481,800 miles a year. Those mileages represent the intrinsic capability of the automobile. However, the normal driver seldom reaches 1/10 of that value in utilizing his automobile.

The effective capacity is a realistic goal. If this person shares his automobile with too many others, it frequently is unavailable when he needs it. A similar system of modifiers could be developed for the use of a private automobile that would demonstrate what its effective utilization capability or capacity per year would be.

The intrinsic throughput capacity for a specific activity in a marine terminal can be defined as follows:

$$C_{HI} = \frac{525{,}600 \times N}{T \times Y}$$

Where C_{HI} = Intrinsic handling capacity, tons per year

N = Number of pieces of equipment (or gangs)

525,600 = Total number of minutes per year

T = Cycle time, minutes per ton

Y = Proportion of total throughput cargo using resource

Realistic assessments of each of the factors defined is necessary to use this formula successfully. In addition, modifiers need to be applied to the intrinsic capacity to estimate the effective throughput capacity. The practical or effective throughput capacity can be defined as:

$$C_{HE} = \frac{C_{HI} \times M_R}{M_T}$$

Where C_{HE} = Effective handling capacity, tons per year

C_{HI} = Intrinsic handling capacity, tons per year

M_R = Resource time modifier

M_T = Cycle time modifier

In a like manner the annual storage capacity of a terminal can be characterized. The intrinsic storage capacity can be expressed as follows:

$$C_{SI} = \frac{365 \times A}{L \times D \times Y}$$

Where C_{SI} = Intrinsic throughput capacity of the storage facilities, tons per year

A = Net storage area, square feet

L = Average area required to store one unit of cargo, square feet per unit

D = Average cargo dwell time, days

Y = Proportion of total throughput cargo using storage area

This intrinsic storage capacity must be modified to reflect conditions outside the operator's direct control. Therefore, the effective throughput capacity is defined as:

$$C_{SE} = C_{SI} \times M_S$$

Where C_{SE} = Effective throughput capacity of the storage facilities, tons per year

C_{SI} = Intrinsic throughput capacity of the storage facilities, tons per year

M_s = Storage capacity modifier

The modifiers specified above are then evaluated based on actual operating conditions for each element of the terminal.

The resource time modifier is based on an analysis of

a. The hours worked per day

b. The days worked per week

c. The vacation days allowed per year

d. The utilization of the facility considering waiting time

e. The availability of equipment to perform each task

f. The effect of peak demands on the facility

The cycle time modifier is based on two factors:

a. The system efficiency or ability to avoid delays

b. Allowance for overstowed cargo that must be moved for access to revenue cargo

The storage capacity modifier is based on two components:

a. The peak storage component reflects overloading due to interplay between vessel and landside transportation schedules.

b. The access component measures the ratio of space for storage to the total space available including provisions for the movement of equipment for cargo handling.

The formulae described above should be applied to each activity in a terminal to determine the effective throughput capacity of each. A typical analysis of a container terminal with a container freight station (CFS) could include an evaluation of the following elements:

a. Ship/apron transfer

b. Apron/container storage transport

c. Container storage/CFS transport

d. Container spots at CFS

e. Truck spots at CFS

f. Interchange spots

g. Customs spots

h. Entrance gates for full export containers

i. Entrance gates for other containers

j. Container exit gates

k. CFS gates

l. CFS storage area

m. Container storage area

An analysis is made of each of these various individual activities, commencing with ship to apron transfer, then to apron to storage transport, storage to truck transfer, and finally movement through the gates to exit the port area. Each individual activity is analyzed separately in order to find what effect it has on the overall throughput capacity

of the terminal. The activity that has the least ability in terms of tonnage per year is then the constraining throughput capacity for the terminal. If ways and means can be found to eliminate the constraint on the lowest capacity activity, the throughput of the terminal then goes to the next higher capacity. Therefore, by removing a series of constraints, the throughput capacity can be increased. The removal of these constraints, if feasible from the economic and environmental point of view, therefore tends to increase the "efficiency" of the terminal in handling the various kinds of cargo.

Another important factor to be considered in port capacity estimation is that throughput capacity is not fixed. It varies considerably with time. Some facilities designed 20 years ago may be completely out of date at this time; others may be obsolescent. Changes in technology, both in materials handling methods and in the ships of the world, cause this dynamic relationship. Thus, the throughput capacity today could be materially different in future years.

A detailed methodology for estimating the capacities of the following types of terminals, with examples of the computations for a typical installation, is included in the NORCAL-2 study:

1. Break-bulk terminal
2. Container terminal
3. LASH terminal

4. Neo-bulk terminal

5. Dry bulk terminal

6. Liquid bulk terminal

7. RORO terminal

8. Multipurpose terminal

San Francisco Bay Area Port Capacities

Employing the methodology described above, the throughput capacities of the following NORCAL member ports were computed by Manalytics, Inc.

Alameda (Encinal Terminals)

Benicia (Benicia Port Terminal Company)

Oakland (Port of Oakland)

Richmond (Port of Richmond)

San Francisco (Port of San Francisco)

Capacities of other ports and private terminals in the Bay Area not under the jurisdiction of the NORCAL ports were not included in this analysis. The characteristics of the various types of terminals in the Bay Area are shown in Table II. The analyses of the terminals show the total annual capacity in Table III; each terminal's capacity is based on the constraining activity that controls the ability of that facility at the present time.

Table II

SAN FRANCISCO BAY AREA
RANGE OF TERMINAL CHARACTERISTICS

	Break-Bulk	Neobulk	LASH/Ctr/RORO	Dry Bulk	Liquid Bulk
Number of berths	34	12	15	3	6
Minimum length, ft	525	566	638	430	700
Maximum length, ft	1,300	1,300	1,355	750	700
Minimum storage per berth	59,000[1]	122,000[1]	170,000[1]	7,000[2]	6,000[2]
Maximum storage per berth	193,000[1]	760,000[1]	821,000[1]	60,000[2]	74,000[2]
Low-range capacity[3]	28,000	27,000	136,000	150,000	72,000
High-range capacity[3]	92,000	270,000	781,000	340,000	470,000

Note: The figures presented above are not averages and should not be used as averages. The capacity figures represent the extremes in range; both the low range and the high range reflect unique conditions at specific berths in the NORCAL ports. The capacities are dictated by the most restrictive constraint at each terminal.

(1) Square feet.
(2) Short tons.
(3) Short tons per year.

TABLE III

SAN FRANCISCO BAY AREA

ANNUAL THROUGHPUT CAPACITY
(Thousands of Short Tons)

	San Francisco	Oakland	Other	Total
Break-bulk	1,400	430	368	2,198
Neobulk	784	580	436	1,800
LASH/container/RORO	1,100	3,726	344	5,170
Dry bulk	230	150	340	720
Liquid bulk	402	320	1,070	1,792
Total	3,916	5,206	2,558	11,680

Note: These capacities are dictated by the most restrictive constraint at each terminal.

CHAPTER IV

FUTURE REQUIREMENTS

A comparison of the foreign and domestic cargo projections that are expected to pass through the San Francisco Bay Area Ports in the next four decades with the annual throughput capacity that is available at present will give an indication of the regional needs that must be met in order to maintain a viable port system in the region. Figure 8 shows the estimated medium projection for dry cargo trade for the San Francisco Bay Area, and indicates that tonnage is expected to double by the mid-1980's. More detail is shown in Table IV which projects the high, medium and low analyses of types of dry cargo projected into the San Francisco Bay Area through the planning period. The total tonnage passing through the Bay Area has little relevancy to overall port planning since different types of facilities are needed for the specific kinds of operations that have been analyzed. Therefore, a brief review of each major type of cargo will provide a better overview of the potential needs of the area.

Break-bulk Cargo

Break-bulk cargo projections from Table IV are shown in Figure 9 and show a relatively low rate of growth in the period up to the end of the century. Also depicted in Figure 9 is the present capacity of Bay Area Ports to handle break-bulk and neo-bulk cargo from Table III--3,998 short tons per year.

TABLE IV

NORTHERN CALIFORNIA AND SAN FRANCISCO BAY
DRY CARGO PROJECTIONS
FOREIGN AND DOMESTIC
MILLIONS OF SHORT TONS

	1973	1980			1990			2000			2020		
		H	M	L	H	M	L	H	M	L	H	M	L
Northern California	13.7	25	18	12	49	36	21	89	58	33	270	164	81
S.F. Bay Area	10.2	19	14	9	37	27	16	66	43	25	200	122	60
Break-bulk	3.7	6	4	3	6	4	3	8	5	3	23	14	7
Dry bulk	3.2	5	4	2	7	6	3	12	8	5	38	23	11
Contain/LASH/RORO	3.3	8	6	4	24	17	10	46	30	17	139	85	42

Note: From Tables LVI, LVIII, LVIX*, NORCAL-1

*Rounded - H = High Projection

M = Medium Projection

L = Low Projection

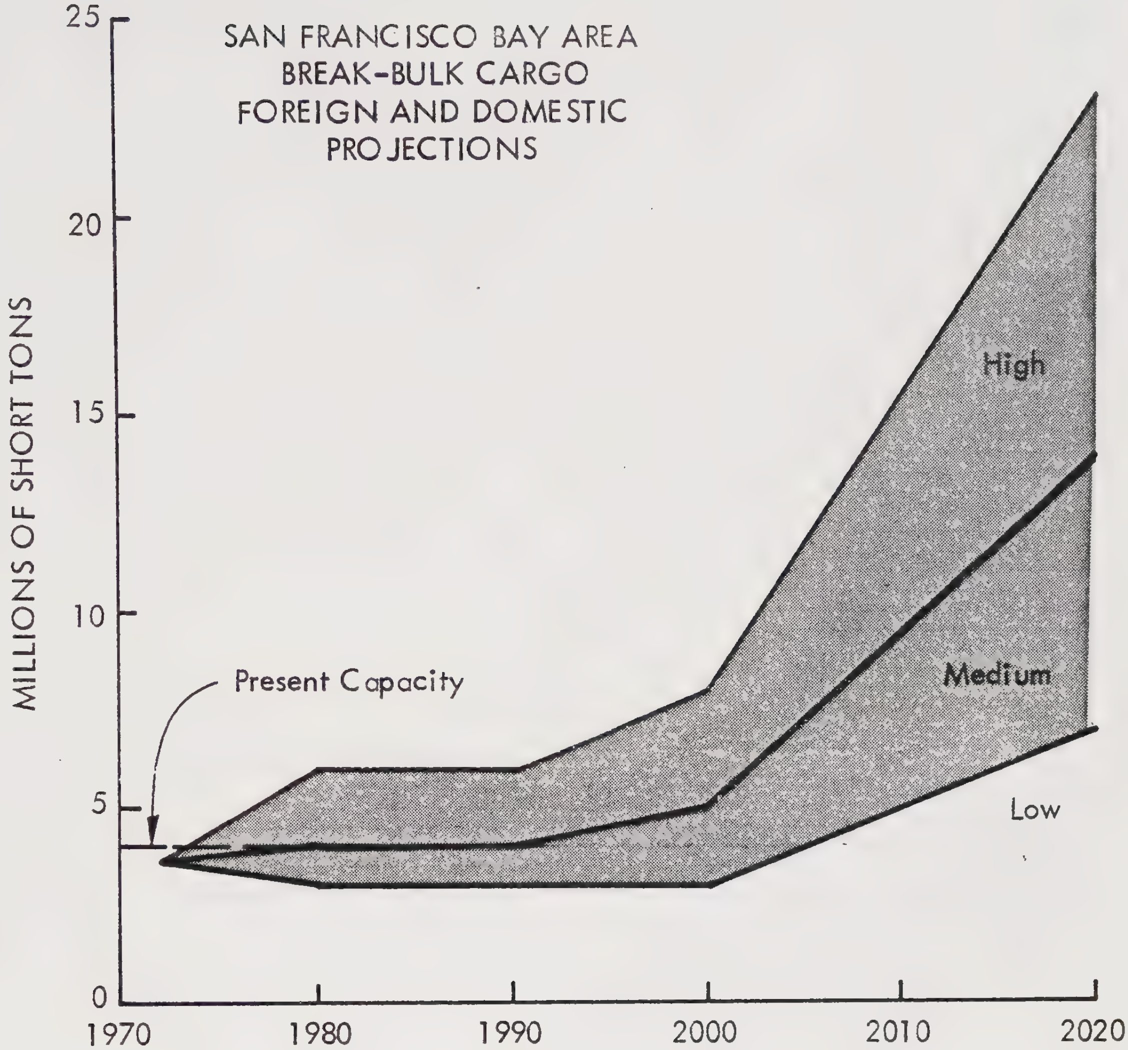
SAN FRANCISCO BAY AREA
BREAK-BULK CARGO
FOREIGN AND DOMESTIC
PROJECTIONS
MILLIONS OF SHORT TONS
25
20
15
10
5
0
1970
1980
1990
2000
2010
2020
Present Capacity
High
Medium
Low

FIGURE 9

Break-bulk and neo-bulk are grouped in this projection because it was not possible to separate the projected demands for these two types of handling methods with any precision in Chapter II.

It is apparent that additional break-bulk and neo-bulk cargo facilities will not be needed in the Bay Area for sometime. It is probable that additional throughput capacity will be needed for specific neo-bulk type operations; for example, the shipment of automobiles, scrap steel or newsprint. The development of capacities to provide for these specialized needs should provide the major growth in terminal capacity for these types of cargoes.

Dry Bulk

The NORCAL ports do not provide for the major capacity for handling dry bulk cargoes in the San Francisco Bay Area (Figure 10). Table III indicates a throughput capacity of 720,000 short tons per year; this can be compared to the 1973 figure of 3,200,000 short tons per year (Table IV) handled by all facilities in the Bay Area.

Figure 10 shows a doubling of need for dry bulk facilities before the end of the century and a sevenfold increase in need by the year 2020. It is probable that some portion of this expanding need will be met by modernization or expansion of facilities at the publicly utilized NORCAL ports. The desires of the shippers and the ability of the single-user terminal operators to expand will affect the portion of the growth that is accommodated in the NORCAL ports.

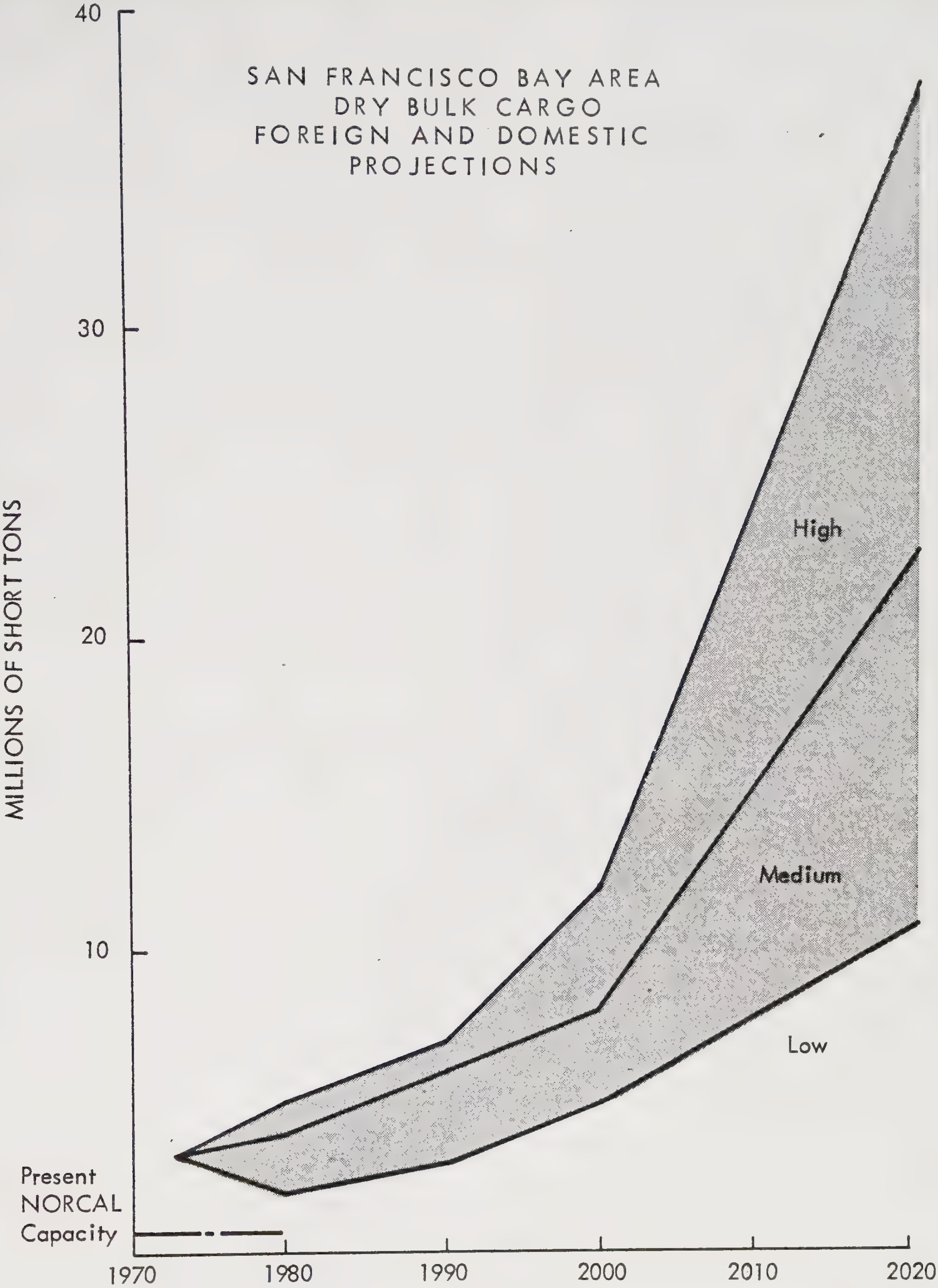
SAN FRANCISCO BAY AREA
DRY BULK CARGO
FOREIGN AND DOMESTIC
PROJECTIONS
MILLIONS OF SHORT TONS
40
30
20
10
High
Medium
Low
Present
NORCAL
Capacity
1970
1980
1990
2000
2010
2020

FIGURE 10

Container/LASH/RORO

A particular emphasis on the handling of container/LASH/RORO types of cargo is necessary because of the high rate of growth projected for cargoes of this type. Although these types of handling do differ considerably, they have been grouped together in this analysis. The cargo projections in Chapter II could not discriminate between the cargoes handled by the three methods sufficiently to warrant separate treatment. At present some of the facilities can handle more than one type of system; on the other hand facilities constructed in the future may have the flexibility to service all of the variations in handling.

Figure 11 shows graphically the projections from Table IV. The present capacity of 5,170 short tons per year from Table III is indicated. The projections demonstrate that in the 1980's the San Francisco Bay Area must double its capacity to handle container/LASH/RORO cargoes; the exact year by which this should be accomplished depends on whether the projections do show that this capacity must be doubled prior to 1990 to meet the needs.

There are several ways that the throughput capacity of the Bay Area terminals can be increased; first, by increased terminal efficiency through application of new technology and/or removal of constraints if economically and environmentally feasible; second, by conversion of existing

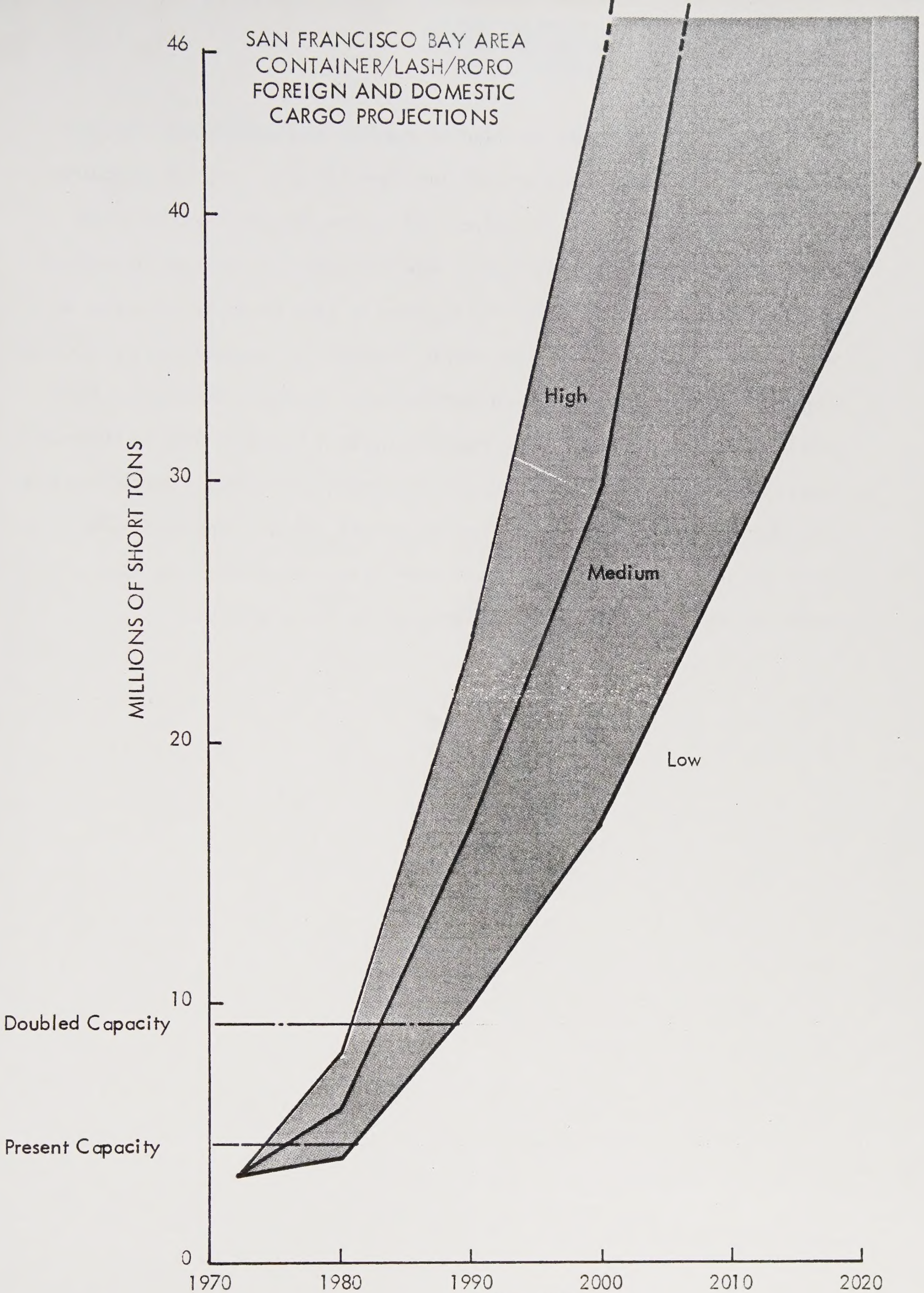
SAN FRANCISCO BAY AREA
CONTAINER/LASH/RORO
FOREIGN AND DOMESTIC
CARGO PROJECTIONS
46
40
30
20
10
0
MILLIONS OF SHORT TONS
High
Medium
Low
Doubled Capacity
Present Capacity
1970
1980
1990
2000
2010
2020

FIGURE 11

obsolescent facilities to handle container/LASH/RORO cargoes; third, by the construction of new facilities. It is probable that a combination of all three of these means will provide the additional capacities that are required. Social, economic and environmental factors will provide the general climate in which the decisions will be made. Specific factors will include depth of water available in natural or dredged channels; land transportation facilities, particularly highways and railroads; institutional abilities and limitations; financial opportunities and constraints. The interrelationship of all these items must be examined in more detail as specific decisions are made on meeting the needs portrayed in this study.